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investigation in other groups of animals will have the same result. Here I shall add another instance. Dr. Murray (*l. c.*, p. 134) gives a list of bipolar species and genera of fishes (after Günther). Now I took the trouble and tried to verify this list, using the recent publications of Jordan and Evermann* and of Goode and Bean†, but I was very much astonished to find that this list is of no value at all. After having found out that of eleven bipolar species of this list at least *five* are really *not* bipolar, and that of twenty-eight bipolar genera at least *five* are to be dropped, and that *seven* more are very doubtful, I did not think it worth while to examine the whole list, since it is evident by these facts that it is utterly devoid of scientific value.

In order to avoid any misunderstanding, I wish it to be understood that I do not deny the possibility of 'bipolarity,' and, indeed, I have myself established at least *one* instance of true bipolarity of a genus (*Orangon*), and I have given an explanation of it. But I protest most emphatically against the view that bipolarity is a striking character of the marine polar faunas, and I also protest against the introduction of doubtful or poorly established facts or of simply incorrect statements or opinions (cf. *Lithodidae*) in support of this 'bipolarity' of species or groups.

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PRINCETON UNIVERSITY, September, 1898.

SCIENTIFIC LITERATURE.

Die Zelle und die Gewebe. Grundzüge der allgemeine Anatomie und Physiologie. OSCAR HERTWIG. Jena, Gustav Fischer. 1898. *Zweites Buch. Allgemeine Anatomie und Physiologie der Gewebe.* Pp. viii + 314. 89 figs. Preis, 7 Mark.

The first part of the work, of which this forms the second and concluding volume, appeared in 1892. Its appearance, as the author tells us in the preface, was due to three reasons: first, to impart to a wider circle of readers the views set forth in his university lectures; second,

the desire to give to his own investigations, scattered in various periodicals and separate publications, a more comprehensive setting; and third, to crown his 'Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbelthiere' with more theoretical views, which could not suitably be included there. "But the second part of the book, which includes the subject of the tissues, and which will be about the same size as the first part, will be in a more special sense a completion of the 'Embryology.' For in it, in addition to the description of the tissues, special emphasis will be laid on their origin or histogenesis, and on the physiological causes of tissue-differentiation." The entire work is thus the result of the life-long observations and reflections of one of the most active and successful of modern biologists. It is the product of a true process of growth, and, probably, a final product; for those who have carefully followed the author's writings of the last six years will not find in this volume much not outlined before.

Perhaps the chief significance of the present volume is that it is the first thorough and consistent exposition of Lamarckian principles, as seen in the light of recent embryological work. The leading idea of the entire exposition is the the author's theory of development, which he names *the theory of Biogenesis*. The three foundation stones of this theory are stated in the twentieth chapter to be: (1) Lamarckism, *i. e.*, 'to use Nägeli's expression, the theory of the specific and direct action' of the environment; (2) 'the doctrine of the inheritance of acquired characters, or their transmissibility through the germ-cells to the offspring;' (3) 'the doctrine of the continuity of the process of development, and the principle of progression, that is to say, that development' (both ontogenetic and phylogenetic) 'progresses steadily in a definite direction.'

The first seven chapters are preliminary, dealing with 'the Stages of Individuality,' 'Specific (Artgleiche), symbiotic and parasitic cell-union,' 'On the Methods of Interdependence of the cells of Organisms,' 'The Law of Causation in its Application to the Organism,' 'On the Causes Separating Cell-aggregates into Tissues and Organs,' and the 'Theory of

*The Fishes of North and Middle America, Bull. U. S. Nat. Mus., 47, 1896.

†Oceanic Ichthyology, Mem. Mus. Comp. Zool., v. 22, 1896.

Biogenesis.' A large part of the volume, beginning with the eighth chapter, is taken up with the consideration of the first foundation-stone of the theory of Biogenesis, viz.: specific and direct action of the environment in the individual development. The factors of development are divided into external and internal; the first being defined (p. 75) as 'the different kinds of relationships to the external world with its numerous forces.' The internal factors are of two sorts, viz.: 'the relations of a cell to all other cells of the same aggregate,' and 'the properties and organization of the sexual cells and their derivatives; the internal factors in the stricter sense.' It would seem likely to us to conduce to more clearness if the first subdivision of the internal factors were reckoned as external factors, as, indeed, they are from the standpoint of the organization of the cells. The author discusses this (p. 75), but thinks otherwise.

Under the head of 'External Factors of Organic development' are discussed: gravity; centrifugal force; mechanical effects of traction, pressure and tension; light, temperature, chemical stimuli; more complex stimuli; organic stimuli, such as grafting, transplantation of tissues, reactions between the embryo and mother, and telegony. These subjects are illustrated with many examples drawn from botany and zoology indifferently. Under the head of 'Internal Relations of Organic Development' we have these subjects: the correlations of cells during cleavage; the correlations of organs and tissues in later stages of development and in the adult; chemical correlations; mechanical correlations; the phenomena of regeneration and of heteromorphosis; and, finally, different conditions and modifications of the cells in the adult, such as hypertrophy, atrophy, metaplasia, hyperplasia and necrosis. The mere reading of such a menu is enough to make one's mouth water; but it must be said that most of this part of the volume is pure description; and the facts are set too much in one light, so that the author apparently loses sight, at times, of the importance of the true internal factors contained in the organization of the cell. However, a great quantity of extremely valuable material is here gathered to-

gether for the first time, and it would be ungracious to quarrel with the point of view, considering the service to the teacher.

The second foundation-stone of the theory is the doctrine of the inheritance of acquired characters. The chapters which illustrate and attempt to substantiate this theory are, in many respects, the most interesting of the entire volume. It is here that we find a consideration of 'the most important category of causes in the process of development,' viz., the inner factors in the narrower sense. Inheritance depends on continuity; "but the great problem, so differently answered in the various theories, is not the continuity of life as such, which is a fact of experience, but the methods and means by which the continuity on which the persistence of a species depends is handed on from member to member of a series of generations." It is impossible to give here a detailed account of Hertwig's views on the mechanism of the inheritance of acquired characters; but, having rejected the transmission of mutilations and of disease, he sums up thus: "Changes in the entirety of an organism produced by alteration of any function during the life of the individual induce, if lasting, alterations in the cells composing the organism, especially in that substance which we have called the bearer of the characteristics of the species" (that is, the idio-plasm contained in the nucleus). "Conditions of the entire organism are thus translated into heritable properties of the cell, in a different material system. The hereditary substance of the organism is thus enriched by a new link, a new possibility, which again becomes manifest in the development of the next generation; thus the new individual now reproduces, to a greater or less extent, from the germ or from inner causes, the properties acquired by the parents in their lifetime through reaction to the environment." He seeks to render the difficulty, of understanding how this translation is possible, less alarming by an analogy, following Hering, between this and the capacity of a nerve-cell to store up impressions and reproduce them again through memory. In both cases the process can be reduced to its most general formula by saying: "External causes exercise influences on a complicated organic

system, which can be stored up in it, and become internal causes, manifesting themselves again, in the sequence, in induced phenomena within the system, for the explanation of which they must be used."

The weakest part of the whole book is the chapter entitled 'Die im Organismus der Zelle enthaltenen Factoren des Entwicklungsprocesses.' For the author, all these factors are included in the nucleus; the protoplasm is isotropic; variation in the size and in the rate of cleavage of the cells are due entirely to the distribution of yolk; and its distribution to gravity. "The accumulation of yolk in the egg-cell undoubtedly exercises a far-reaching influence on the course of development, impressing on it a special character. *On this account* many investigators have been induced to regard the egg as something more than a simple cell," etc. (*italics mine*). "But the character of the egg as a simple cell is not in the least altered by the accumulation of material in it." Whitman is supposed to hold this idea, that the degree of organization of the egg is proportional to the amount of yolk in it. Such a grotesque conception of Dr. Whitman's views is inexcusable. To say that "the inequalities which arise in the size and the arrangement of the embryonic cells and in their yolk-contents have nothing to do with the differentiation of organs" is simply untrue, as is proved by the whole subject of cell-lineage, which has put the problem here discussed in an entirely new light, about which a voluminous literature has already arisen, but which is not even mentioned by Hertwig. Think of such a phrase as this: "the organization of the egg, which depends on the inclusion of deutoplasm!" (p. 265).

The third foundation-stone of the theory of Biogenesis is the principle of progression. A single quotation will suffice to indicate what is meant by this: "Placing ourselves upon the theory of descent, might we not suppose that species develop according to the principle of a steady progression regulated by law, like the multicellular organism by epigenesis from the egg, not as the sport of circumstances, but with the same innate necessity that causes the gastrula to succeed the blastula in ontogenesis?"

The principal points of view of the theory of

Biogenesis are summarized by Hertwig in the concluding pages; they may be condensed thus:

1. "Since all organisms pass through the unicellular conditions in their development, all constant or essential characters by which species is distinguished from species must be contained in their simplest form, or, so to speak, reduced to their simplest expression in this. There are thus as many fundamentally different species of cells as there are different species of plants and animals."

2. The essential distinctions between these cells are not directly discernible. But from logical considerations we are forced to assume "that the cells possess a finer micellar organization exceeding our powers of observation, by virtue of which they are the bearers of the properties of the species," and that this substance, the idioplasm, makes up only a small part of the whole substance of the cell. "According to our theory it is contained in the nucleus."

3. "The cause of continuity in development is that each individual is the product of a cell possessing the same specific properties."

4. As to the causes of the development of the individual from the species-cell, the theory of Biogenesis postulates 'the increase of the species-cell and the correlative process of social union, division of labor and integration.'

5. The process of cleavage is a multiplication of the original cell, all products possessing the same fundamental organization.

6. "The aggregate takes on definite forms during its growth, which in any stage are the expression of: (1) the influence of innumerable, external factors; but still more (2) of the endlessly complicated effects which the constantly increasing elementary units exercise on one another."

7. "Within the series of generations of persons, or between the separate ontogenies, the continuity of development is preserved by single cells freeing themselves from the aggregate of the species-cells and becoming the origin of a new process of development."

In conclusion, I cannot avoid criticising the name which the author has chosen for his theory of development. It is not in any sense

a theory of *Biogenesis*. We are told on page 236 that the name was given to express the idea 'that the origin of the complex organism is to be explained from the properties of an elementary being, the cell.' If only it did express this!

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Animal Intelligence. By WESLEY MILLS. New York, The Macmillan Co. 1898. Pp. x + 307.

The first fifty pages of Professor Mills' book are made up of certain theoretical discussions. The rest consists in the main of reprints from the *Transactions, Royal Society of Canada*, already familiar to those who follow the progress of animal psychology. In his theorizing Professor Mills refuses the moderate attitude of Lloyd Morgan, Wundt and other recent psychologists and reverts to a position comparable to that of Romanes. He even calls Lindsay's writings 'admirable.' Here is no place to refute his claims; it will suffice to say that he leaves the problem in the loose and unprofitable form of more or less 'intelligence' instead of resolving it into definite questions about the presence or absence of particular mental processes. Moreover, he wastes his energy on such straw men as the theory that all the actions of animals are due to instinct or that human minds were created especially of quite different stuff. One novelty in his discussion is the insistence that human conceit makes men under-rate animals' capacities. When one thinks of the wide prevalence of animal-worship, of the reverent eulogies of instinct so common in books of the middle of this century, or of his own experience of present opinion about animals, this notion of Professor Mills seems extraordinarily perverse. I should say that we naturally tend to do quite the opposite, to interpret animals' acts by our own minds, and, when any strange act appears, to explain it in the most glorified way possible.

The observations which are recorded in the book concern the habits of squirrels, hibernation, and the early life of dogs, cats, rabbits, guinea-pigs, pigeons and chicks. Such records are of the greatest value, and to Professor Mills is due the credit of doing more of such work, I sup-

pose, than any one else has yet done. The development of the sense-powers, the presence of instinctive reactions of various sorts, the correlation of physical growth with mental development, the formation of habits—data concerning all these are given. One could praise them unreservedly were it not for Professor Mills' habit of occasionally mixing up opinion with observation. On page 139, for instance, he says: "I notice that the precocious bitch acts towards the whip much as an *old dog* or a half-grown one often does. This is difficult to describe. The animal shows that it understands what its relations are, but seems to combine a sort of pleading with humor." The last sentence is a good record of Professor Mills' attitude toward animal psychology, but it is worthless as far as concerns the dog. In harmony with his general theory Professor Mills finds in these young animals signs of reasoning, a moral sense and a sense of humor. Many would interpret these signs very differently.

In closing I wish to say a little about the observational method of studying animal psychology. Without forgetting a single one from among its advantages, the fact remains that, unless you practice continuous observation from birth, you do not get complete control of the animal's experience. Actions which you observe in one hour out of the twenty-four may be due to experience acquired during the remaining twenty-three. The meaning of phenomena is also often dubious. Why then neglect specific experiments, even if you have to use unnatural surroundings? It would seem that if Professor Mills had used a part of his time in making crucial experiments to decide definite questions, he would at least have had a means of checking his other results. Finally, I would beg that anyone who is studying animal psychology to throw light on the human mind, to leave the poor dogs and cats and guinea-pigs and above all the favorite chicken, to feel their feelings in peace and devote himself to the monkeys. Since Hubrecht has shown how early the primate stock split off, it seems far-fetched to call a dog-mind and cat-mind an ancestor in any sense of the human.

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